Display/Exhibit/Museum

- Goals and Approach
- Quality and Quantity
- Design Issues for Specific Applications and Areas
- Specialized Lighting Systems / Equipment

- Museums and art galleries collect, preserve, analyze, and display natural artifacts and examples of human achievement and their impact on us.
- Effective exhibit lighting must balance exhibition and conservation needs and enrich the museum experience.
- Exhibit lighting impacts several important groups, including museum curatorial, educational, and conservation staff; designers; and visitors. Effective museum lighting must balance the concerns of each group.

- Goals and Approach
- Quality and Quantity
- Design Issues for Specific Applications and Areas
- Specialized Lighting Systems / Equipment

a b c d

Paintings, sculptures, and art objects are effectively lighted with track lights, which can be aimed to provide an even wash of light over an object (a) or to emphasize certain features, such as color or texture (b). In (c) light from several directions models the sculpture and provides a dramatic background of shadows that are as interesting to look at as the sculpture itself. In (d) daylight is admitted into this gallery through a translucent skylight, and the amount of light transmitted is carefully controlled. Track lighting provides both supplementary general illumination and accent lighting for the ornamental objects (hand-painted screens) in this exhibit.

- Goals and Approach
- Quality and Quantity
- Design Issues for Specific Applications and Areas
- Specialized Lighting Systems / Equipment




- Goals and Approach
- Quality and Quantity
- Design Issues for Specific Applications and Areas
- Specialized Lighting Systems / Equipment






Systems Approach Solution

- Goals and Approach
- Quality and Quantity
- Design Issues for Specific Applications and Areas
- Specialized Lighting Systems / Equipment

Artifact conservation and display requirements should be determined based on the following:

- Low illuminance can compromise the visual enjoyment of an artifact but can still cause some damage. There is no point in causing any damage if the artifact cannot be seen well.
- The institution should decide how much illuminance and how much exposure time is acceptable, that is, what artifact lifetime is desirable.
- The institution should determine the sensitivity to light of each artifact or group of artifacts as accurately as possible.

Display/Exhibit/Museum

- Goals and Approach
- Quality and Quantity
- Design Issues for Specific Applications and Areas
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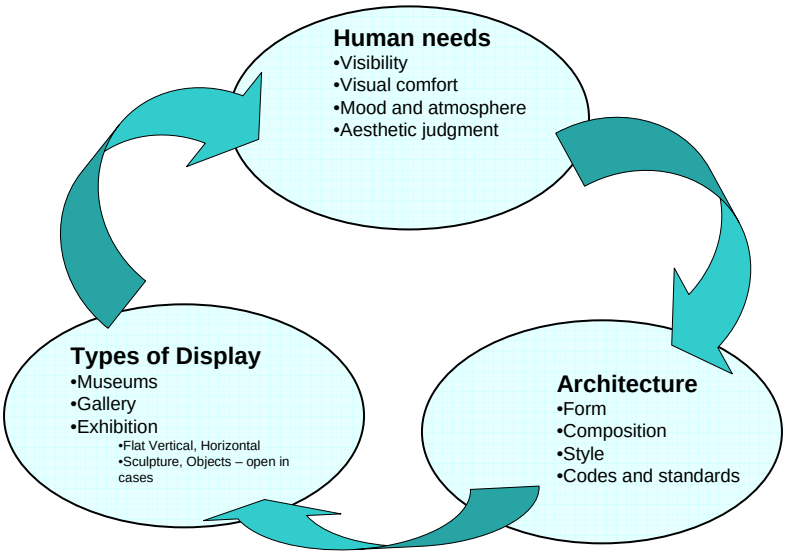
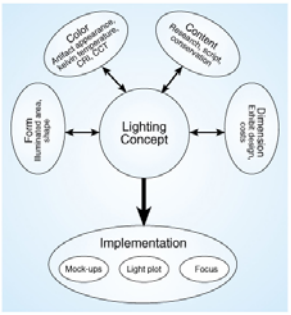


Design Guidelines

- Goals and Approach
- Quality and Quantity
- Design Issues for Specific Applications and Areas
- Specialized Lighting Systems / Equipment

Museum and art gallery lighting design differs in some important respects from many other types of lighting design. Museum objects are often unique in size, shape, texture, and color, and many are extremely sensitive to light damage. Lighting design becomes a selective visibility process that governs what we see, how we see it, and when we see it.



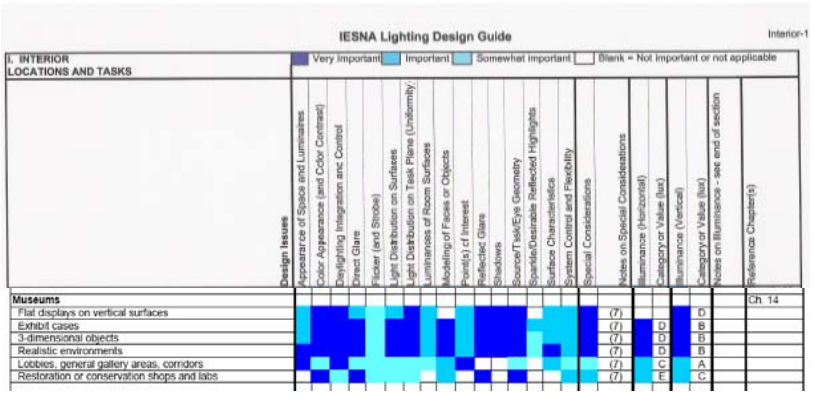
The Design Concept. Concept development begins by analyzing the reasons for the exhibition and identifying the dominant elements. The designer should then put these ideas into a simple, declarative sentence expressing the lighting concept. This statement becomes the "channel" through which the design flows. Concept development facilitates implementation.

Color. Using color in museums is different from using color in other places because the color of the light source should not change the look of an artifact, that is, affect its "original appearance." Thus enhancement of certain colors with selective colored light is usually inappropriate when lighting museum artifacts.

IESNA Illumination Guide

- Goals and Approach
- Quality and Quantity
- Design Issues for Specific Applications and Areas
- Specialized Lighting Systems / Equipment

Museum Lighting


IESNA Lighting Design Guide

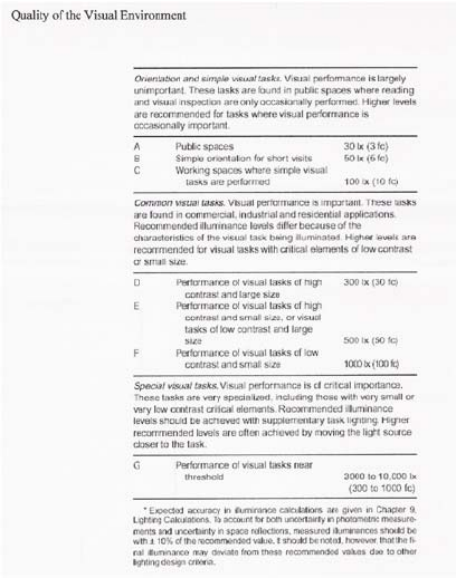
Interior-1

I. INTERIOR LOCATIONS AND TASKS — Very Important | Important | Somewhat important | Blank = Not important or not applicable

Design Issues	Appearance of Space and Luminaires	Color Appearance (and Color Contrast)	Daylighting Integration and Control	Direct Glare	Flicker (and Strobe)	Light Distribution on Surfaces	Light Distribution on Task Plane (Uniformity)	Luminances of Room Surfaces	Modeling of Faces or Objects	Point(s) of Interest	Reflected Glare	Shadows	Source/Task/Eye Geometry	Sparkle/Specular Reflected Highlights	Surface Characteristics	System Control and Flexibility	Special Considerations	Notes on Special Considerations	Illuminance (Horizontal)	Category or Value (lux)	Illuminance (Vertical)	Category or Value (lux)	Notes on Illuminance - see end of section	Reference Chapter(s)
Museums																								Ch. 14
Flat displays on vertical surfaces																		(7)				D		
Exhibit cases																		(7)				B		
3-dimensional objects																		(7)				B		
Realistic environments																		(7)				B		
Lobbies, general gallery areas, corridors																		(7)				A		
Restoration or conservation shops and labs																		(7)				C		

IESNA Illumination Guide

- Goals and Approach
- Quality and Quantity
- Design Issues for Specific Applications and Areas
- Specialized Lighting Systems / Equipment



Quality of the Visual Environment

Orientation and simple visual tasks. Visual performance is largely unimportant. These tasks are found in public spaces where reading and visual inspection are only occasionally performed. Higher levels are recommended for tasks where visual performance is occasionally important.

A	Public spaces	30 lx (3 fc)
B	Simple orientation for short visits	50 lx (5 fc)
C	Working spaces where simple visual tasks are performed	100 lx (10 fc)

Common visual tasks. Visual performance is important. These tasks are found in commercial, industrial and residential applications. Recommended illuminance levels differ because of the characteristics of the visual task being illuminated. Higher levels are recommended for visual tasks with critical elements of low contrast or small size.

D	Performance of visual tasks of high contrast and large size	300 lx (30 fc)
E	Performance of visual tasks of high contrast and small size, or visual tasks of low contrast and large size	500 lx (50 fc)
F	Performance of visual tasks of low contrast and small size	1000 lx (100 fc)

Special visual tasks. Visual performance is of critical importance. These tasks are very specialized, including those with very small or very low contrast critical elements. Recommended illuminance levels should be achieved with supplementary task lighting. Higher recommended levels are often achieved by moving the light source closer to the task.

G	Performance of visual tasks near threshold	2000 to 10,000 lx (300 to 1000 fc)

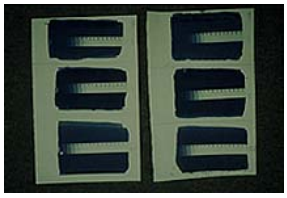
* Expected accuracy in illuminance calculations are given in Chapter 9, Lighting Calculations. To account for both uncertainty in photometric measurements and uncertainty in space reflections, measured illuminances should be with ± 15% of the recommended value. It should be noted, however, that the final illuminance may deviate from these recommended values due to other lighting design criteria.

Damage To Museum Objects

- Goals and Approach
- Quality and Quantity
- Design Issues for Specific Applications and Areas
- Specialized Lighting Systems / Equipment

Effects of Exposure to Light

- Light is radiant energy, and exposure to light gradually causes permanent damage to many museum objects. When radiant energy is incident on the surface of a material, whether opaque or transparent, some portion of that energy is absorbed. This can promote two distinctly different processes that can cause degradation of museum objects: radiant heating and photochemical action.
- Radiant heating produces a temperature rise at the surface of the material exposed to the source of energy. The surface expands relative to the body of the object, and moisture is driven from the surface material. The symptoms are surface cracking, lifting of surface layers, and loss of color.



Damage To Museum Objects

- Goals and Approach
- Quality and Quantity
- Design Issues for Specific Applications and Areas
- Specialized Lighting Systems / Equipment

Light Source	UV (μW/lm)	UV (percent)
Incandescent and tungsten-halogen		
Incandescent (CIE Source A , 2850 K)	75	1.7
PAR38 tungsten-halogen	67	1.4
MR16 tungsten-halogen, dichroic, with glass cover	36	0.9
MR16 tungsten-halogen, aluminized, with glass cover	95	1.9
Fluorescent		
Range* lowest	80	2.0
highest	280	8.3
Typical* F40RE730	130	3.4
F40RE830	140	4.6
Daylight		
Overcast sky (6500 K) outdoors	540	12.0
Overcast sky through glass	410	9.5
Skylight + sunlight (5500 K) outdoors	350	8.3
Skylight + sunlight through glass	275	6.7

* The UV output of a fluorescent lamp depends on the phosphor coating and on the type and thickness of the glass. Range values give the highest and lowest values likely to be encountered. Typical values give two examples of currently available lamps.

Absolute and Relative Amounts of Ultraviolet (UV) Radiation from Electric and Natural Light Sources Useful to Museum Applications

Types of Materials	Maximum Illuminance	Lux-Hours Per Year*
Highly susceptible displayed materials: textiles, cotton, natural fibers, furs, silk, writing inks, paper documents, lace, fugitive dyes, watercolors, wool, some minerals	50 lux	50,000
Moderately susceptible displayed materials: textiles with stable dyes, oil paintings, wood finishes, leather, some plastics	200 lux	480,000
Least susceptible displayed materials: metal, stone, glass, ceramic, most minerals	Depends on exhibition situation	

Note: All UV radiation (400 nm and below) should be eliminated. The visible spectrum is defined as extending from 380 nm to 760 nm. Museum conservators treat all wavelengths shorter than 400 nm as UV; the damage potential is high below this wavelength and the visual effect is very small.

* These values follow the reciprocity principle, and therefore the maximum illuminance values can be altered for different annual exposure times.

Recommended Total Exposure Limits in Terms of Illuminance Hours per Year

Four Typical Lighting Situations

- Goals and Approach
- Quality and Quantity
- Design Issues for Specific Applications and Areas
- Specialized Lighting Systems / Equipment

Most museum exhibit displays can be categorized into one of four groups:

- flat displays on vertical surfaces
- display cases,
- three-dimensional objects, and
- realistic environments.

Within each group, the lighting designer must deal with unique challenges and creative opportunities.

Flat Displays on Vertical Surfaces

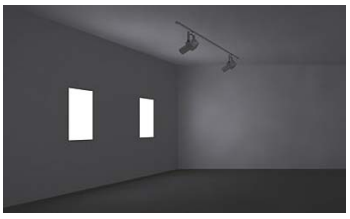
- Goals and Approach
- Quality and Quantity
- Design Issues for Specific Applications and Areas
- Specialized Lighting Systems / Equipment

Uniform illumination of large vertical displays presents a common lighting problem in museums. Paintings, prints, documents, and explanatory labels are included in this important category.

Lighting becomes difficult when acrylic or glass is used to protect the artifact. The combination of the specular surface and improperly placed luminaires can cause reflected glare and obscure the artifact.

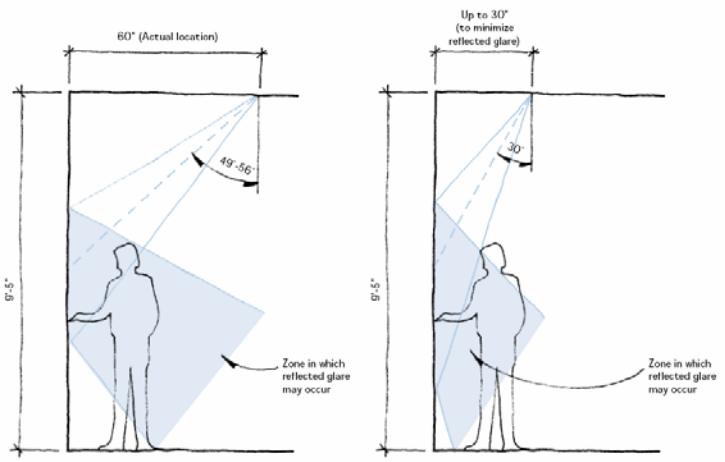
Flat Displays on Vertical Surfaces

- Goals and Approach
- Quality and Quantity
- Design Issues for Specific Applications and Areas
- Specialized Lighting Systems / Equipment



Flat Displays on Vertical Surfaces

- Goals and Approach
- Quality and Quantity
- Design Issues for Specific Applications and Areas
- Specialized Lighting Systems / Equipment

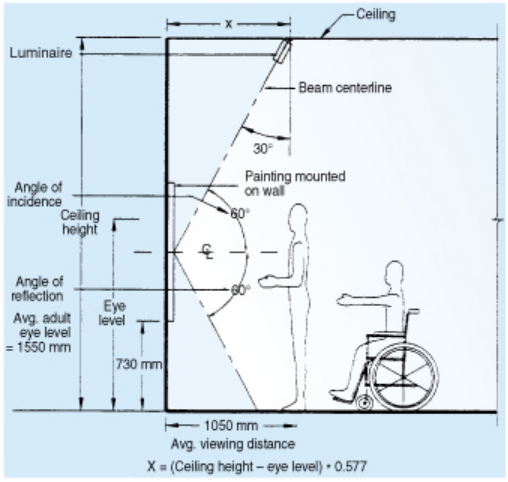


Reflected glare on a glossy whiteboard can occur when a luminaire is mounted at a distance greater than 30 inches from the board.

Reflected glare can be minimized by mounting the luminaire up to 30 inches from the board to form an angle of less than 30° from vertical.

Flat Displays on Vertical Surfaces

- Goals and Approach
- Quality and Quantity
- Design Issues for Specific Applications and Areas
- Specialized Lighting Systems / Equipment



Guidelines for luminaire mounting position for flat displays on vertical surface. Use the formula as a guide. Increase or decrease "X" as required to avoid shadows from oversize frames on paintings. Compute the angle of incidence/reflection to avoid glare to viewer.

Exhibit Cases

- Goals and Approach
- Quality and Quantity
- Design Issues for Specific Applications and Areas
- Specialized Lighting Systems / Equipment

Museum exhibit cases allow visitors to approach rare and delicate artifacts closely while maintaining a barrier against degradation, vandalism, or theft.

Cases usually contain small, delicate, and valuable artifacts.

Display cases (vitrines) can have either mullions at the corners or clear acrylic or tempered glass panels glued at the edges.

Exhibit Cases

- Goals and Approach
- Quality and Quantity
- Design Issues for Specific Applications and Areas
- Specialized Lighting Systems / Equipment

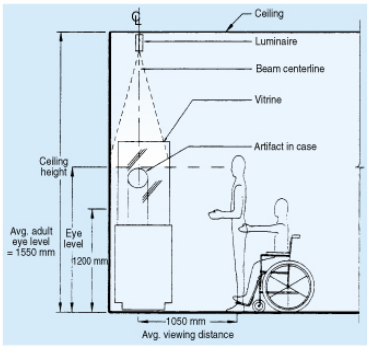


Exhibit Cases

- Goals and Approach
- Quality and Quantity
- Design Issues for Specific Applications and Areas
- Specialized Lighting Systems / Equipment

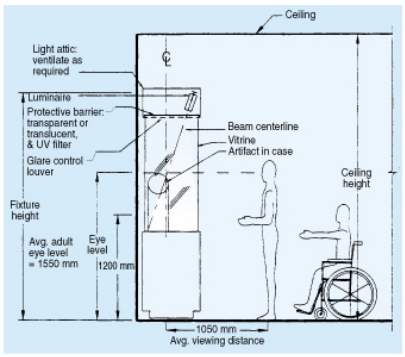
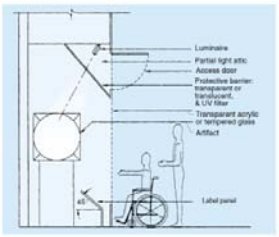
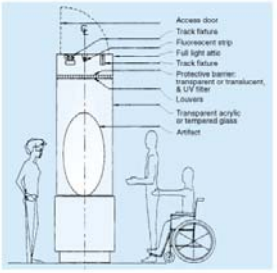


Exhibit Cases

- Goals and Approach
- Quality and Quantity
- Design Issues for Specific Applications and Areas
- Specialized Lighting Systems / Equipment



Guidelines for luminaire mounting position for a display case, with the luminaire inside a partial light attic.



). Guidelines for luminaire mounting position for a display case, with the luminaire inside a full light attic.

Three-Dimensional Objects

- Goals and Approach
- Quality and Quantity
- Design Issues for Specific Applications and Areas
- Specialized Lighting Systems / Equipment

Irrespective of size, a three-dimensional artifact must be illuminated from several different directions. Light from multiple directions models a sculpture, expressing depth by highlighting some areas while allowing others to fall into shadow.

Consider, for example, a bronze figure with a patina of light blue, green, and gray coloring. Light sources from different angles render these hues with lesser or greater emphasis.

Three-Dimensional Objects

- Goals and Approach
- Quality and Quantity
- Design Issues for Specific Applications and Areas
- Specialized Lighting Systems / Equipment

Highlight and Shadow. Highlights give a good visual clue about surfaces, but care must be used so that highlights do not become dazzling or hypnotically repetitive. Shadow is a good indicator of surface forms and textures, provided it is not so strong as to conceal relevant detail.

Three-Dimensional Objects

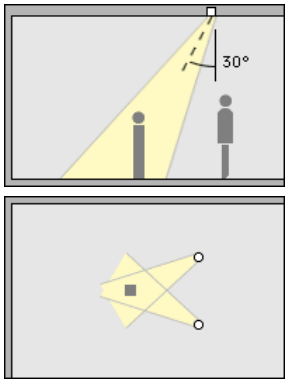
- Goals and Approach
- Quality and Quantity
- Design Issues for Specific Applications and Areas
- Specialized Lighting Systems / Equipment

Minimizing Glare. There are few problems for the viewer when an object at eye level or lower is lighted from all sides where the center beam axis of the luminaire is 30° or less from the vertical. For a small, low object, the luminaires should be steeply angled, limiting the risk of glare for the observer on the opposite side. When an object is tall, some light may go past the display and cause glare for viewers on the far side looking upward at it. Solutions to this problem include:

- Angling the luminaires sharply down and relieving shadows with a high-reflectance pedestal
- Keeping light beams entirely within the mass of the display
- Illuminating objects from below as long as appearances are not distorted
- Using overall soft lighting (fill light) in the display space so that all objects can be readily seen, while focusing a narrow beam (key light) on the important parts of each object
- Lighting the background behind the artifact

Three-Dimensional Objects

- Goals and Approach
- Quality and Quantity
- Design Issues for Specific Applications and Areas
- Specialized Lighting Systems / Equipment



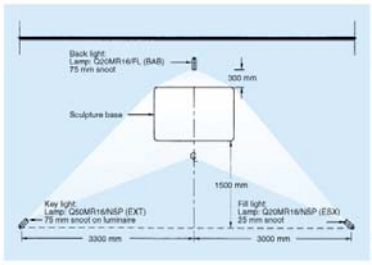
Objects can be illuminated with light directed from between 30° to 45° to the vertical. The steeper the incident light, the more pronounced the three-dimensionality of the illuminated object.

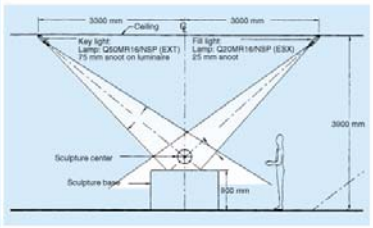
If the angle of incidence of the light is approximately 30°, the so-called "museum angle", this produces maximum vertical lighting and avoids reflected glare that may disturb the observer.

In the case of reflecting surfaces, e.g. oil paintings or pictures framed behind glass, attention must be paid to the angle of incidence of the light to avoid disturbing reflections that may arise in the observer's field of vision. This will also avoid any heavy shadow, e.g. picture frame shadows on the picture.

Three-Dimensional Objects

- Goals and Approach
- Quality and Quantity
- Design Issues for Specific Applications and Areas
- Specialized Lighting Systems / Equipment





Realistic Environments

- Goals and Approach
- Quality and Quantity
- Design Issues for Specific Applications and Areas
- Specialized Lighting Systems / Equipment

- Museums sometimes create realistic environments, where the space itself becomes the message. Examples include period rooms, outdoor scenes, or historic houses. Lighting in character with the original purpose of the space is desirable, within reason.
- Clearly, realistic exhibit spaces require compromises. The lighting designer can employ at least two techniques to achieve realistic lighting: concealed lighting positions and dual lighting systems.

Realistic Environments

- Goals and Approach
- Quality and Quantity
- Design Issues for Specific Applications and Areas
- Specialized Lighting Systems / Equipment

Concealed Lighting.

Concealed lighting locations require definitive viewing positions, highlighted prominent display features, and adequate light for visitor safety.

Dual Lighting.

A dual lighting system uses control equipment that alternates, either automatically or manually, between realistic lighting and good display lighting. The display lighting should complement the realistic lighting in both style and color. Electric lighting must substitute for original flame source lighting (candles, mantles, gas jets) for safety and conservation reasons. (Any real flame would emit unwanted soot and water vapor into the display area.) Electric light that very slowly alternates between the glow emitted by a gas jet and the intensity required for easy viewing can be very effective.

Realistic Environments

- Goals and Approach
- Quality and Quantity
- Design Issues for Specific Applications and Areas
- Specialized Lighting Systems / Equipment




Luminaires And Accessories

- Goals and Approach
- Quality and Quantity
- Design Issues for Specific Applications and Areas
- Specialized Lighting Systems / Equipment

Typical museum and art gallery interior lighting applications include:

General lighting
Accent lighting
Indirect lighting
Case or cabinet lighting
Flood lighting
Special effects lighting
Safety lighting

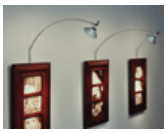
Track lighting systems serve a dual purpose: connecting a light source to the power source and supporting the luminaire. Care should be taken not to overload the track, both electrically and physically, with too many luminaires

- Goals and Approach
- Quality and Quantity
- Design Issues for Specific Applications and Areas
- Specialized Lighting Systems / Equipment

Specialized Lighting Systems



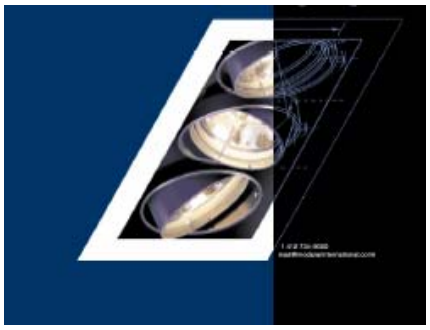


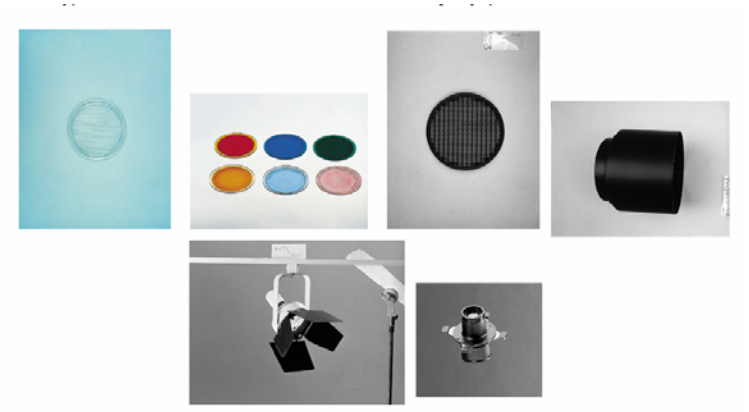

Retail Lighting/Display/Exhibit/Museum

- Goals and Approach
- Quality and Quantity
- Design Issues for Specific Applications and Areas
- Specialized Lighting Systems / Equipment

Specialized Lighting Systems



- Goals and Approach
- Quality and Quantity
- Design Issues for Specific Applications and Areas
- Specialized Lighting Systems / Equipment



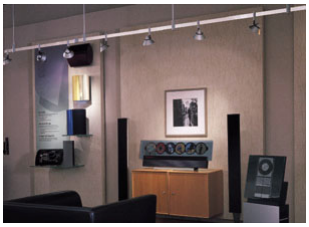
- Goals and Approach
- Quality and Quantity
- Design Issues for Specific Applications and Areas
- Specialized Lighting Systems / Equipment

Exhibit/Museum Lighting

- **Primary Balance**
  - Occupant Comfort/long-term system economy
  - Clarity of the object and accuracy of color

- Goals and Approach
- Quality and Quantity
- Design Issues for Specific Applications and Areas
- Specialized Lighting Systems / Equipment

Exhibit/Museum Lighting



- Goals and Approach
- Quality and Quantity
- Design Issues for Specific Applications and Areas
- Specialized Lighting Systems / Equipment

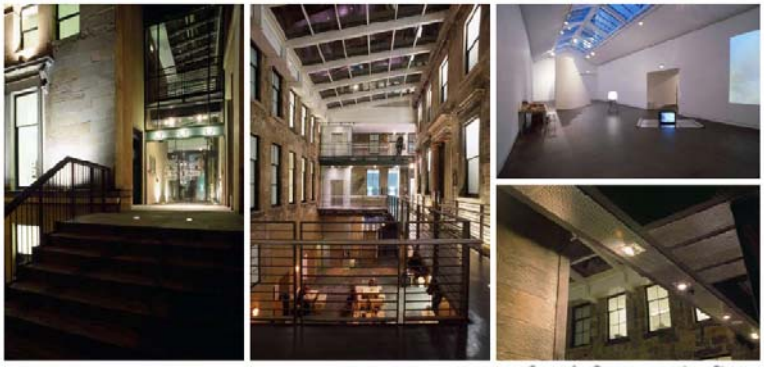
Exhibit/Museum Lighting

- Goals and Approach
- Quality and Quantity
- Design Issues for Specific Applications and Areas
- Specialized Lighting Systems / Equipment

Exhibit/Museum Lighting

Centre of Contemporary Arts, Glasgow

- Goals and Approach
- Quality and Quantity
- Design Issues for Specific Applications and Areas
- Specialized Lighting Systems / Equipment



Museum of Scotland, England

- Goals and Approach
- Quality and Quantity
- Design Issues for Specific Applications and Areas
- Specialized Lighting Systems / Equipment

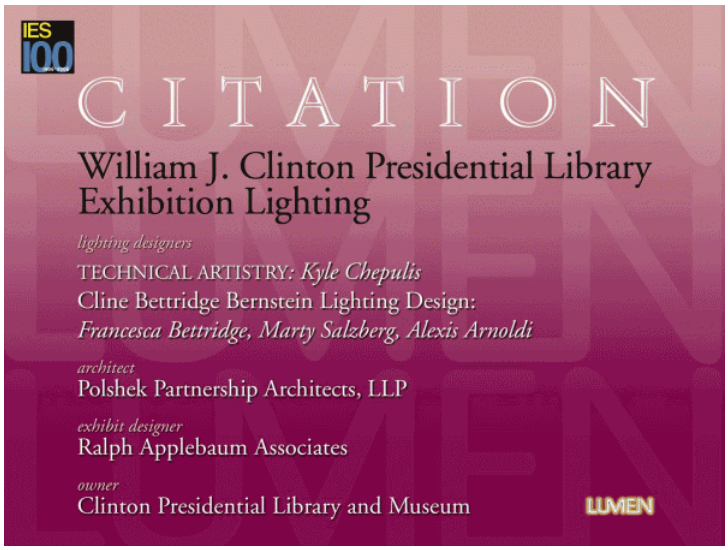
St. Mungos Museum of Religious Life and Art

- Goals and Approach
- Quality and Quantity
- Design Issues for Specific Applications and Areas
- Specialized Lighting Systems / Equipment

Singapore Art Museum, Singapore

- Goals and Approach
- Quality and Quantity
- Design Issues for Specific Applications and Areas
- Specialized Lighting Systems / Equipment

- Goals and Approach
- Quality and Quantity
- Design Issues for Specific Applications and Areas
- Specialized Lighting Systems / Equipment



Museum of Fine Arts, Boston

- Goals and Approach
- Quality and Quantity
- Design Issues for Specific Applications and Areas
- Specialized Lighting Systems / Equipment

Corning Museum of Glass

- Goals and Approach
- Quality and Quantity
- Design Issues for Specific Applications and Areas
- Specialized Lighting Systems / Equipment

Corning Museum of Glass

- Goals and Approach
- Quality and Quantity
- Design Issues for Specific Applications and Areas
- Specialized Lighting Systems / Equipment

- Goals and Approach
- Quality and Quantity
- Design Issues for Specific Applications and Areas
- Specialized Lighting Systems / Equipment

Nasher Sculpture Center

- Goals and Approach
- Quality and Quantity
- Design Issues for Specific Applications and Areas
- Specialized Lighting Systems / Equipment

Jewish Museum, Berlin

- Goals and Approach
- Quality and Quantity
- Design Issues for Specific Applications and Areas
- Specialized Lighting Systems / Equipment

Museum of Modern Art , NY

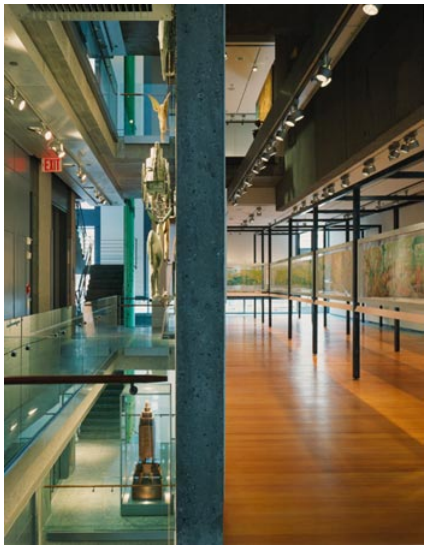
- Goals and Approach
- Quality and Quantity
- Design Issues for Specific Applications and Areas
- Specialized Lighting Systems / Equipment

Pulitzer Foundation

- Goals and Approach
- Quality and Quantity
- Design Issues for Specific Applications and Areas
- Specialized Lighting Systems / Equipment

American Folk Art Museum, NY

- Goals and Approach
- Quality and Quantity
- Design Issues for Specific Applications and Areas
- Specialized Lighting Systems / Equipment

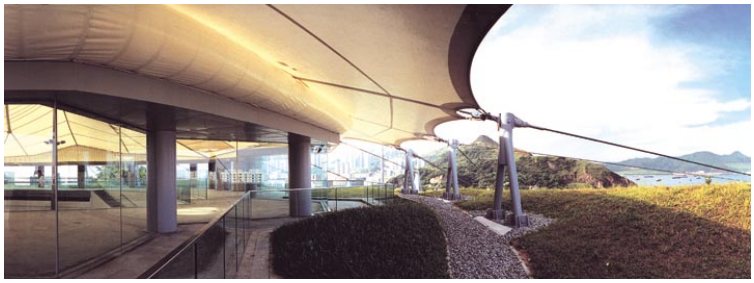


Seattle Art Museum

- Goals and Approach
- Quality and Quantity
- Design Issues for Specific Applications and Areas
- Specialized Lighting Systems / Equipment

Museum of Coastal Defense

- Goals and Approach
- Quality and Quantity
- Design Issues for Specific Applications and Areas
- Specialized Lighting Systems / Equipment



British Museum: London England

- Goals and Approach
- Quality and Quantity
- Design Issues for Specific Applications and Areas
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